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Takase et al.

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(54) **LIGHT SOURCE APPARATUS AND LIQUID CRYSTAL DISPLAY APPARATUS**

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G02F 1/1335 (2006.01)
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(58) **Field of Classification Search**
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See application file for complete search history.

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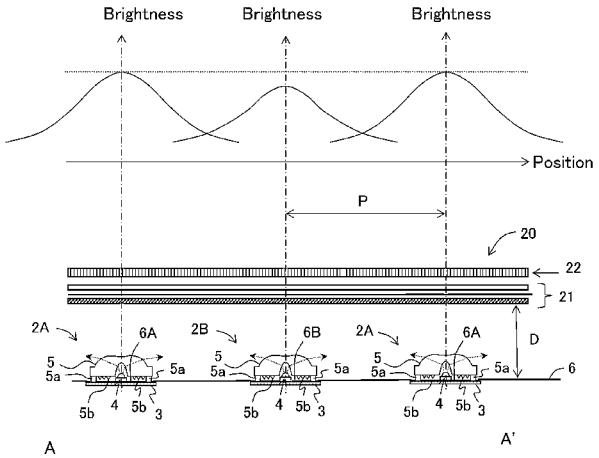
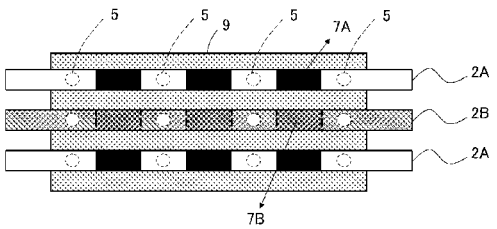
(74) *Attorney, Agent, or Firm* — Birch, Stewart, Kolasch & Birch, LLP

(57) **ABSTRACT**

Unevenness in brightness of a plane light source is controlled to improve a display quality of a plane light source. An LED module comprising one or a plurality of light source sections with a high brightness peak value and a large light and dark contrast difference, and an LED module comprising one or a plurality of light source sections with a low brightness peak value and a small light and dark contrast difference, are alternately arranged. The one or the plurality of light source sections comprise a white resist arranged on a substrate region around LED, as a reflection material. The light source section with a large brightness peak value and a large light and dark contrast difference, and the light source with a low brightness peak value and a small light and dark contrast difference, are formed by the difference in a reflection rate of the white resist.

13 Claims, 10 Drawing Sheets





(51) **Int. Cl.**

F21K 99/00	(2010.01)
F21V 7/22	(2006.01)
F21V 13/04	(2006.01)

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Fig.1

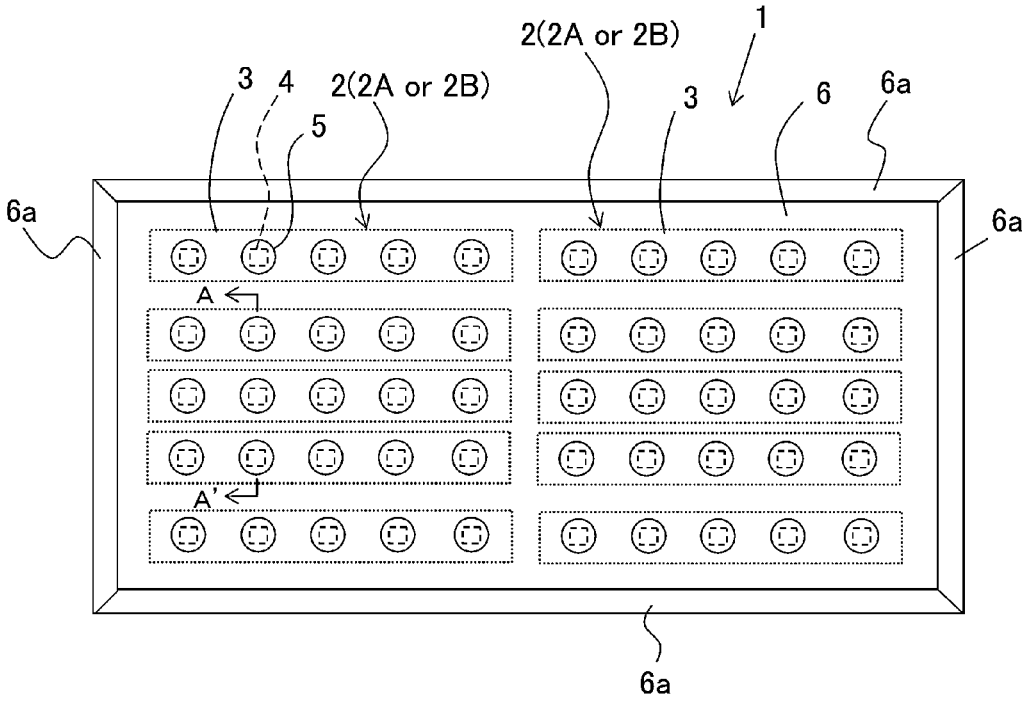
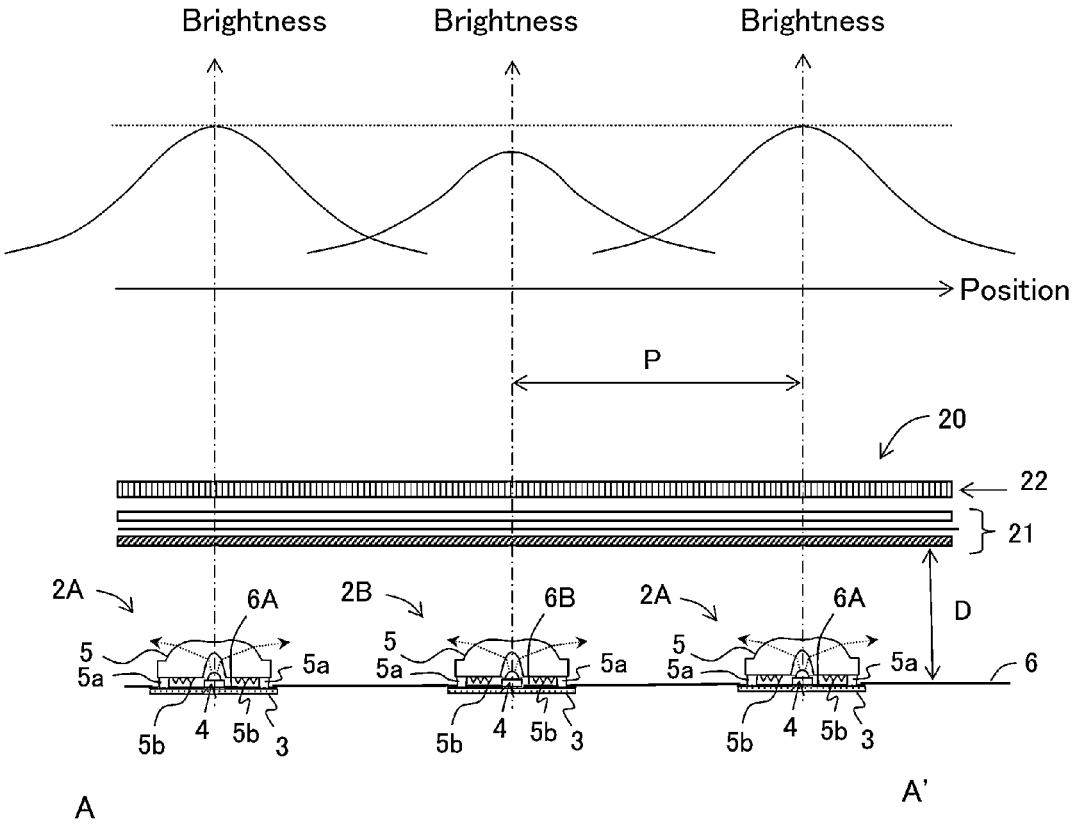


Fig.2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Brightness
Brightness
Position
P
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22
21
D
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6A
2B
6B
2A
6A
5
5a
5a
5
5a
5a
5
5a
5a
6
5b
4
5b
3
5b
4
5b
3
5b
4
5b
3
A
A'

Fig.3

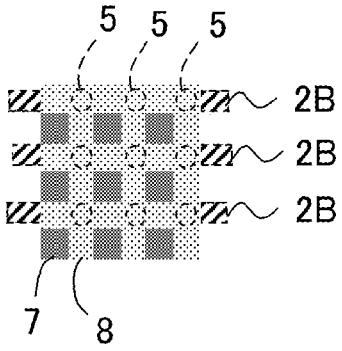


Fig.4

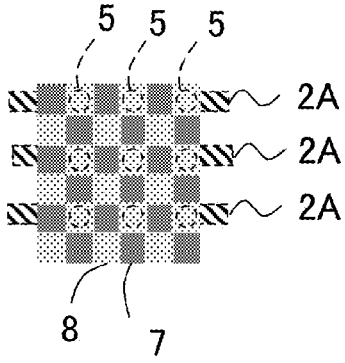
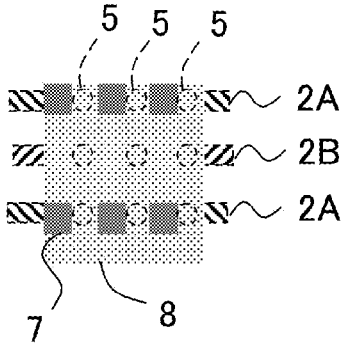


Fig.5



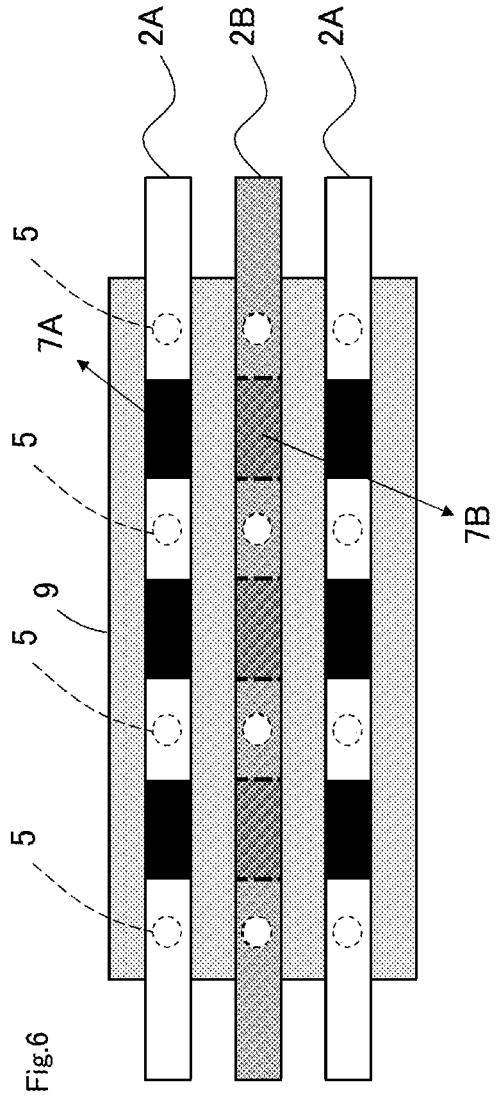
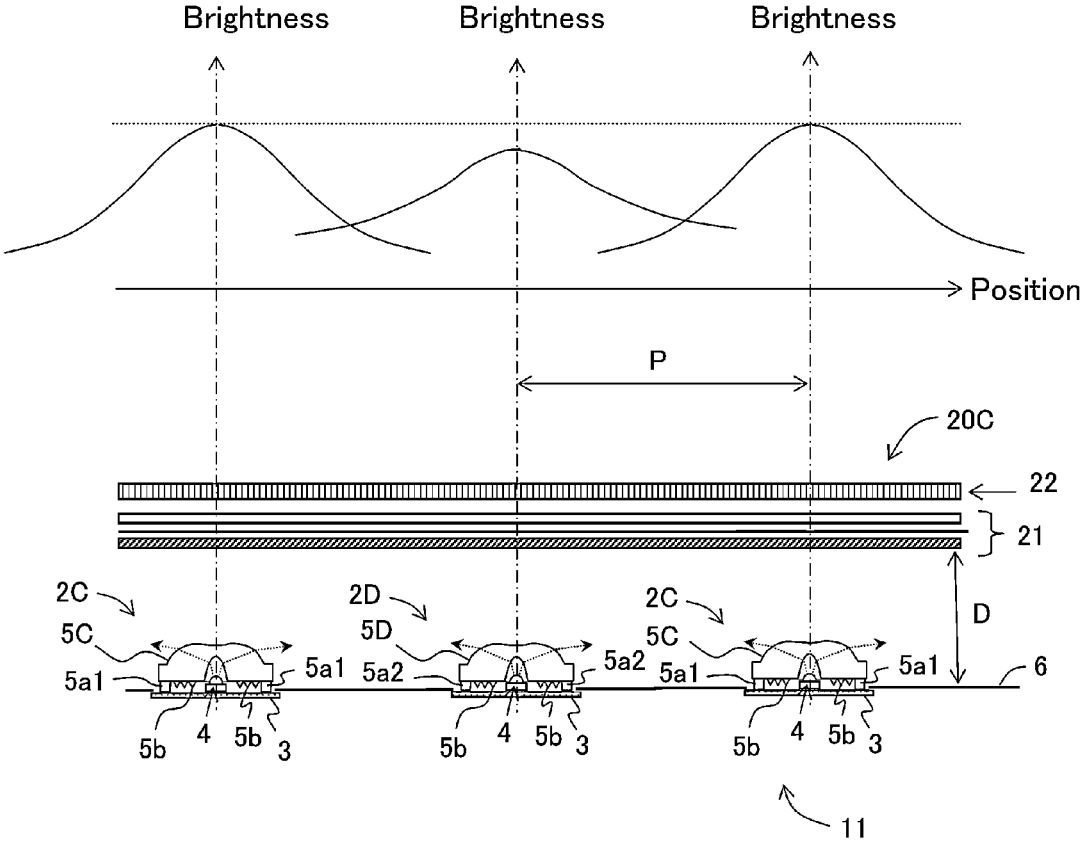


Fig.6

Fig.7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Brightness
Brightness
Position
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2D
5D
5a2
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6
11

Fig.8

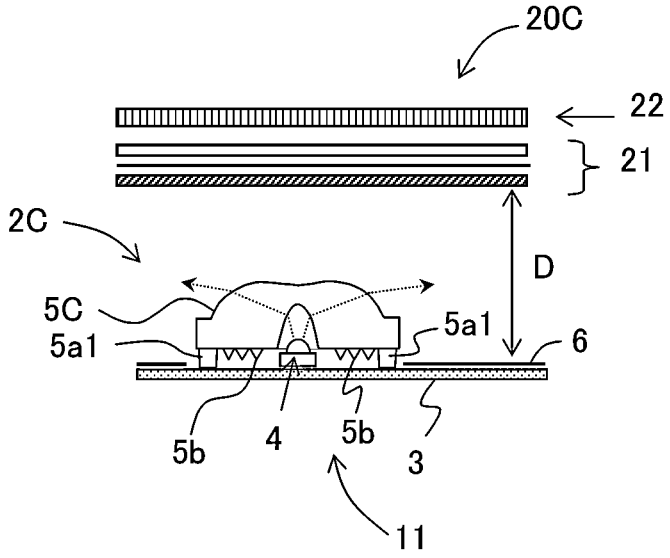


Fig.9

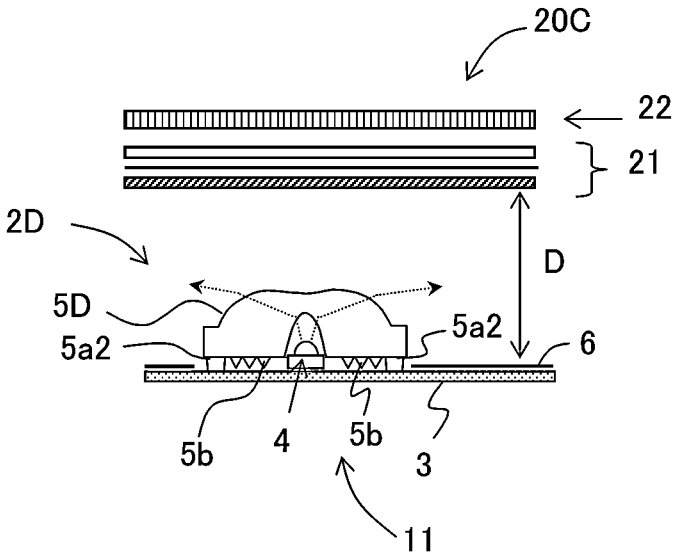


Fig.10

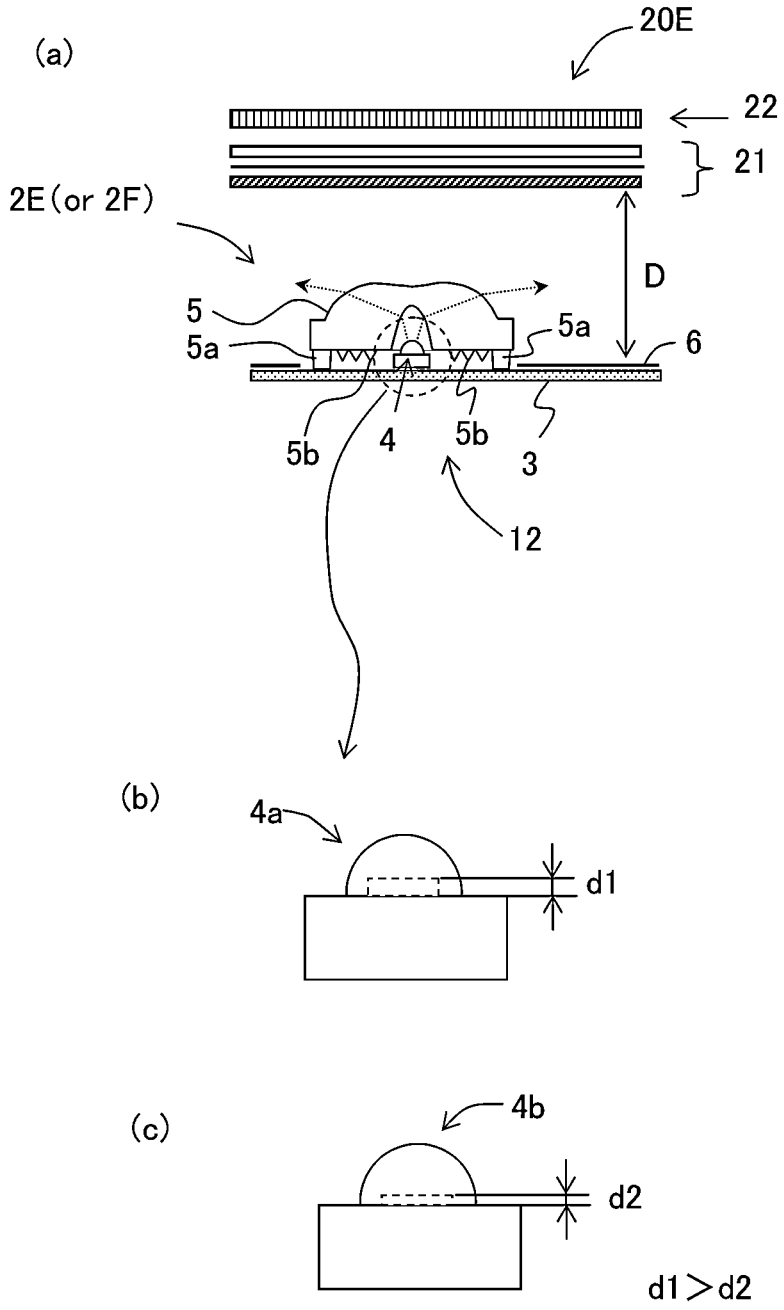


Fig.11

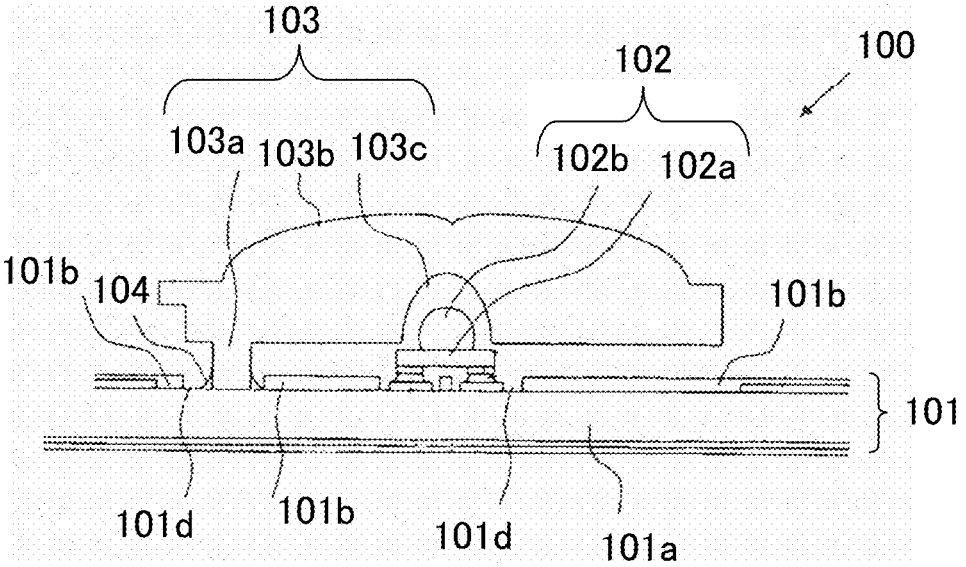
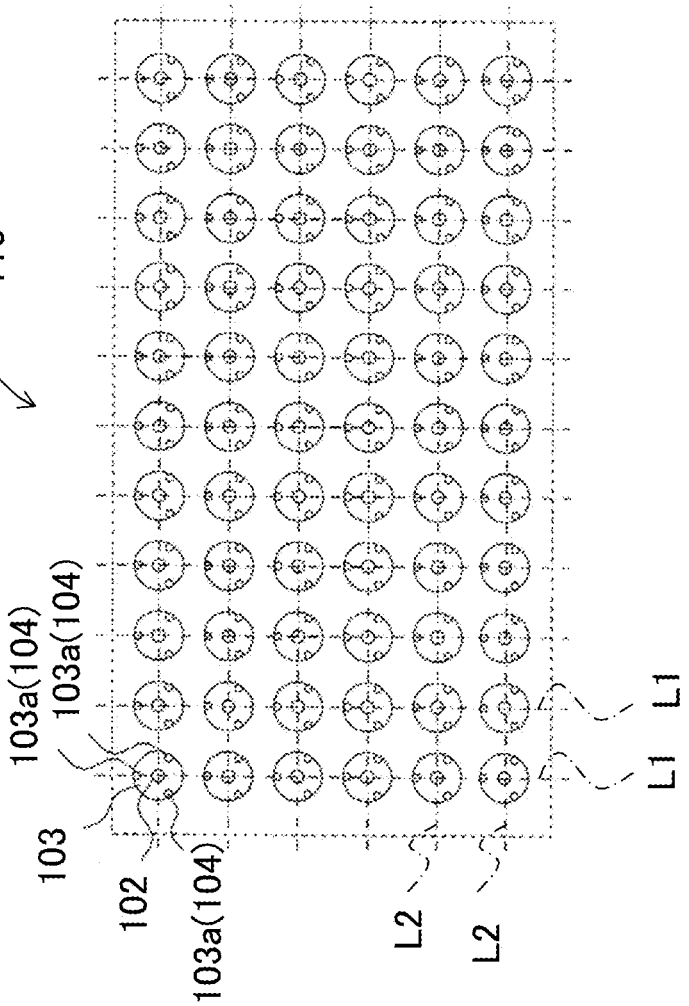

103
102
100
103a
103b
103c
102b
102a
101b
104
101b
101
101d
101b
101d
101a

Fig.12



LIGHT SOURCE APPARATUS AND LIQUID CRYSTAL DISPLAY APPARATUS

TECHNICAL FIELD

The present invention relates to a light source apparatus, in which a plurality of LED modules and the like equipped with a plurality of light emitting diodes (LED) as a light source, are used and also relates to a liquid crystal display apparatus in which the light source apparatus is used as a back light.

BACKGROUND ART

Conventional liquid crystal display devices of this type have a transmissive liquid crystal panel, and a backlight is used in the back of the transmissive liquid crystal panel. For the light source apparatus used as a backlight, CCFL (Cold Cathode Fluorescent Lamp) has conventionally been a main stream. However, with recent progress in LED technology, use of the LED as a light source is regarded as promising instead of using the CCFL.

In a direct LED backlight of Patent Document 1, a method is used for controlling streaked and uneven brightness due to the overlapping of shadows created by pillars and adhesive resin of optical lenses blocking light from a light emitting element. However, optical diffusing lenses used therein are all the same.

FIG. **11** is a longitudinal cross sectional view showing a configuration example of an essential part of a conventional light emitting module, on which a light emitting element disclosed in Patent document 1 is mounted. FIG. **12** is a plane view showing an arrangement example of optical lenses in a plane emitting unit on which a plurality of light emitting element modules of FIG. **11** are mounted.

As shown in FIG. **11**, in a light emitting element module **100**, a plurality of light emitting element parts **102** are mounted on a substrate **101** as light emitting elements, the light emitting element parts **102** being equipped with LEDs and the light emitting element parts **102** being arranged either in one column or in a plurality of columns.

In the substrate **101**, wiring is provided on a base material **101***a* formed by impregnating, for example, a resin (epoxy resin, cyanate resin and the like) into woven or non-woven, glass fiber, organic fiber or the like. White insulation material (white resist and the like) **101***b* is formed on the uppermost surface of the substrate **101** in such a manner to cover a region except for a land part in the wiring. Covering the uppermost surface of the substrate **101** with the white insulation material **101***b* increases reflection rate of light from the light emission elements and increases light irradiation amount to a display area, in addition to protecting the wiring. Note that ordinary solder resist can be used if a reflection sheet is provided separately on the surface of the substrate.

In a light emitting element part **102**, one or a plurality of LED chips (not shown) are mounted on a part substrate **102***a* such as ceramic, and the LED chips are electrically connected to the part substrate **102***a* with wires (not shown). Thus, the LED chips and wires are formed by being sealed by a sealing resin **102***b*. For the seal resin **102***b*, transparent resin such as silicon is used, and fluorescent materials are added as needs arise.

The substrate **101** has an opening **101***d* which is not covered with the insulating materials **101***b*. In the opening **101***d*, an optical lens **103** and the base material **101***a* of the substrate **101** are fixed with adhesive resin **104**.

The size of the opening **101***d* is the same as, or slightly greater than, that of a bottom surface of a pillar **103***a* of the optical lens **103**. As such, providing the opening **101***d* the size of which is the same as or slightly greater than the size of the bottom surface of the pillar **103***a* facilitates the positioning of the adhesive resin **104**, thus facilitating the control of resin amount. If the amount of the adhesive resin **104** is too much, then the adhesive resin **104** will rise up to the bottom surface of the lens section **103***b* of the optical lens **103**, or will spread to the surface of substrate **101** beyond the opening **101***d*. As a result, transmitted light may be blocked or absorbed at the bottom surface of the lens section **103***b* or the pillar **103***a*, which may influence the diffusion of light from the light emitting element.

At the center of the optical lens **103**, a recess **103***c* is formed for partially housing the light emitting element part **102** from the bottom. The light emitting element part **102** is not sealed and has a layer of air between the light emitting element part **102** and the recess **103**C, which provides favorable heat radiation of the light emitting element part **102**.

In addition, in a conventional plane light emission unit **110** as shown in FIG. **12**, pillars **103***a* of each of optical lenses **103** and adhesive resins **104** adjacent to each other are arranged to commonly prevent a straight line L**1** in a longitudinal direction and a straight line L**2** in a transverse direction, where the lines connect the centers of the light emitting element parts **102** adjacent to each other. As a result, shadows created by pillars **103***a* of the optical lenses **103** and adhesive resins **104** blocking light from a light emitting element will not overlap with each other, thereby controlling the occurrence of streaked and uneven brightness.

PRIOR ART DOCUMENTS

Patent Documents

Patent Document 1: Japanese Laid-Open Publication No. 2011-40376

SUMMARY OF THE INVENTION

Problems to be Solved by the Invention

In the above conventional plane light emitting unit **110** disclosed in Patent Document 1, when the light diffusing lenses **103** are arranged in a matrix and in a longitudinal and transverse array as shown in FIG. **12**, the spread of individual light of many of the light emitting element parts **102** link with light of an adjacent light diffusing lens **103**. Therefore, uneven emission of light is likely to occur, which is a certain pattern of longitudinal streaks, transverse streaks and oblique streaks as a whole backlight. In particular, uneven emission of streaks occurring throughout an entire screen are obvious to human eyes, which is one of the reasons that reduces a display quality.

Unevenness of the same type occurring continuously at a proximal position is more visible to human eyes than unevenness of the same type occurring at a location farther than the proximal position, even if the two types of unevenness have the same brightness difference.

In addition, when the distance between a light emitting element and a light diffusing sheet is narrowed down to performance limitation or when the pitch distance of light emitting elements mounted in a planar manner is widened to performance limitation, there arises a problem with a conventional configuration with a single light distribution property, of insufficient spreading of light from the center of the light emitting element to the peripheral portion depending on a deviation in properties due to variation on production of light

emitting element modules. Thus, the brightness is relatively decreased at the middle point between the light emitting elements in a plane view, and the brightness immediately above the light emitting elements is relatively increased to generate lattice like unevenness, which affects the display quality.

The present invention is intended to solve the conventional problems described above. It is an objective of the present invention to provide: a light source apparatus capable of controlling brightness unevenness of a plane light source to increase display quality of the plane light source; and a liquid crystal display apparatus with the light source apparatus used therein.

Means for Solving the Problem

A light source apparatus according to the present invention comprises a plurality of light emitting element modules provided therein, in which one or a plurality of light emitting elements are mounted on a substrate, for emitting light planarly, where a light source section causing first unevenness and a light source section causing second unevenness are alternately arranged, so that the first unevenness and the second unevenness are relieved with each other, thereby achieving the objective described above.

Preferably, in the light source apparatus according to the present invention, alight source section causing lattice like unevenness by a light part and a light source section causing oblique like unevenness by a light part are alternately arranged for each row or each column when a plurality of light source sections are arranged in a matrix in a row direction and a column direction in a plane view.

A light source apparatus according to the present invention comprises a plurality of light emitting element modules provided therein, in which one or a plurality of light emitting elements are mounted on a substrate, for emitting light planarly, the light source apparatus further comprising a light source section with a narrow light distribution property and a light source section with a broad light distribution property being alternately arranged for each row or each column when a plurality of the light source sections are arranged in a matrix in a row direction and a column direction in a plane view, thereby achieving the objective described above.

Preferably, in a light source apparatus according to the present invention, a light source section with a large light and dark contrast difference and a light source section with a small light and dark contrast difference are alternately arranged in the light emitting element module for each row or each column when a plurality of the light source sections are arranged in a matrix in a row direction and a column direction in a plane view.

Still preferably, in a light source apparatus according to the present invention, a light emitting element module comprising one or a plurality of light source sections with a large light and dark contrast difference, and a light emitting element module comprising one or a plurality of light source sections with a small light and dark contrast difference, are alternately arranged.

Still preferably, in the light emitting element module in the light source apparatus according to the present invention, a light source section with a large light and dark contrast difference and a light source section with a small light and dark contrast difference are alternately arranged.

Still preferably, in the light source apparatus according to the present invention, the light source section comprises a reflecting material provided on a substrate region around the light emitting element, in addition to the light emitting element; and the light source section with the large light and dark contrast difference and the light source section with the small light and dark contrast difference are formed by the difference in a reflection rate of the reflecting material.

Still preferably, in the light source apparatus according to the present invention, a lens is mounted for each light emitting element, and the substrate region around the light emitting element is a substrate region immediately below the lens.

Still preferably, in the light source apparatus according to the present invention, a light source section with a narrow light distribution angle and a light source section with a broad light distribution angle are alternately arranged when a plurality of the light source sections are arranged in a matrix in a row direction and a column direction in a plane view.

Still preferably, in the light source apparatus according to the present invention, the light emitting element module comprising the one or the plurality of light source sections with the narrow light distribution angle, and the light emitting element module comprising the one or the plurality of light source sections with the broad light distribution angle are alternately arranged.

Still preferably, in the light source apparatus according to the present invention, the light source section with the narrow light distribution angle and the light source section with the broad light distribution angle are alternately arranged in the light emitting element module.

Still preferably, in the light source apparatus according to the present invention, the light source section comprises the light emitting element and the lens mounted for each light emitting element; and the light source section with the narrow light distribution angle and the light source section with the broad light distribution angle are formed by the difference in at least any of a length of a plurality of principal pillars of the lens, a thickness of the lens and a shape of the lens.

Still preferably, in the light source apparatus according to the present invention, the light source section comprises the light emitting element; and the light source section with the narrow light distribution angle and the light source section with the broad light distribution angle are formed by the difference in a height of the one or the plurality of light emitting sections of the light emitting element.

Still preferably, in the light source apparatus according to the present invention, the light source section comprises the light emitting element; and the light source section with the narrow light distribution angle and the light source section with the broad light distribution angle are formed by the difference in a shape of a sealing section through which light from the light emitting element is emitted.

A liquid crystal display apparatus according to the present invention comprises the light source apparatus according to the present invention provided on a back surface side of a liquid crystal panel, to be used as a backlight, thereby achieving the objective described above.

With the above structure, the operation of the present invention will be described.

According to the present invention, in a light source apparatus in which a plurality of light emitting element modules having one or a plurality of light emitting elements mounted on a substrate are provided for planar light irradiation, when a plurality of light source sections are arranged in a matrix and in row and column directions in a plane view, a light source section with a narrow light distribution property and a light source section with a broad light distribution property are alternately arranged for each row or each column.

Accordingly, the light source section with a narrow light distribution property and the light source section with a broad light distribution property are alternately arranged, Thus, a

light source section having large light emission brightness on an optical axis passing through a light emitting element and small light emission brightness in a peripheral part away from the optical axis, is combined with a light source section having small light emission brightness on the optical axis passing through the light emitting element than the light emission brightness on the optical axis at the first light source section, and having large light emission brightness in a peripheral part away from the optical axis than light emission brightness at the peripheral part away from the optical axis of the first light source section, thereby relieving the decrease in emission brightness between the light source sections. As a result, the difference in brightness is relieved immediately above the light source section and between the light source sections. Thereby, it becomes possible to control the brightness unevenness of the plane light source and increase a display quality of the plane light source.

In addition, since the difference in brightness is relieved immediately above the light source section and between the light source sections and the unevenness in brightness is controlled on a screen, a pitch between the light emitting elements can be widened, and as a result, the number of light source sections, including light emitting elements, are reduced.

Effects of the Invention

From the foregoing, according to the present invention, a light source section having large light emission brightness on an optical axis passing through a light emitting element and small light emission brightness in a peripheral part away from the optical axis, is combined with a light source section having small light emission brightness on the optical axis passing through the light emitting element than the light emission brightness on the optical axis at the first light source section, and having large light emission brightness in a peripheral part away from the optical axis than light emission brightness at the peripheral part away from the optical axis of the first light source section, thereby relieving the decrease in emission brightness between the light source sections. As a result, the difference in brightness is relieved immediately above the light source section and between the light source sections, and it becomes possible to control unevenness in brightness on a screen visually sensed by humans. As a result, it becomes possible to increase a display quality of the plane light source.

As such, since the difference in brightness is relieved immediately above the light source section and between the light source sections and the unevenness in brightness is controlled on a screen, the pitch between the light emitting elements can be widened, and as a result, the numbers of light source sections can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a plane view schematically showing an example of an LED module arrangement of an LED light source apparatus according to Embodiment 1 of the present invention.

FIG. **2** is a longitudinal cross sectional view of a section AA' schematically showing a configuration example of an essential part of a liquid crystal display apparatus with the LED light source apparatus in FIG. **1** incorporated therein and is also a figure showing brightness according to positions corresponding to the section AA'.

FIG. **3** is a plane view schematically showing positions of light diffusing lenses and light and dark portions of brightness, in the case of providing only an LED module in which brightness is set to be low by a reflection rate of a white resist.

FIG. **4** is a plane view schematically showing positions of light diffusing lenses and light and dark portions of brightness, in the case of providing only an LED module in which brightness is set to be high by a reflection rate of a white resist.

FIG. **5** is a plane view schematically showing positions of light diffusing lenses and light and dark portions of brightness in the case of Embodiment 1 alternately arranging an LED module having a high brightness peak and a larger difference in light and dark contrast, and an LED module having a low brightness peak and a small difference in light and dark contrast, in units of substrate section.

FIG. **6** is a plane view schematically showing an arrangement example of three LED modules in the LED light source apparatus in FIG. **1**.

FIG. **7** is a partial longitudinal cross sectional view schematically showing a configuration example of an essential part of a liquid crystal display apparatus having an LED light source apparatus according to Embodiment 2 of the present invention incorporated therein, and is also a figure showing brightness according to positions corresponding to the subject cross-section.

FIG. **8** is a partial longitudinal cross sectional view schematically showing a configuration example of an essential part of a liquid crystal display apparatus, for describing a light source section with a narrow light distribution angle.

FIG. **9** is a partial longitudinal cross sectional view schematically showing a configuration example of an essential part of a liquid crystal display apparatus, for describing a light source section with a broad light distribution angle.

FIG. **10**(*a*) is a partial longitudinal cross sectional view of a liquid crystal display apparatus having a variation of an LED light source apparatus according to Embodiment 2 of the present invention incorporated therein; FIG. **10**(*b*) is side view of an LED in the case of a height d**1** of a light emitting section within the LED; and FIG. **10**(*c*) is a side view of an LED in the case of a height d**2** of a light emitting section which is lower than a height d**1** of the light emitting section in FIG. **10**(*b*).

FIG. **11** is a longitudinal cross sectional view showing a configuration example of an essential part of a conventional light emitting element module having a light emitting element disclosed in Patent Document 1 mounted thereon.

FIG. **12** is a plane view showing an arrangement example of optical lenses in a plane light emitting unit having a plurality of light emitting element modules of FIG. **11** mounted thereon.

REFERENCE SIGNS LIST

1, **11**, **12** LED light source apparatus (light source apparatus)
2 LED module (light emitting element module)
2A LED module in which brightness is set to be high and a light and dark contrast difference is set to be large
2B LED module in which brightness is set to be low and a light and dark contrast difference is set to be small
2C, **2**F LED module in which a light distribution angle is set to be narrow
2D, **2**E LED module in which a light distribution angle is set to be broad
3 printed circuit board
4, **4***a*, **4***b* LED (light emitting element)
5, **5**C, **5**D light diffusing lens (lens)
5*a*, **5***a***1**, **5***a***2** pillar
5*b* diffusing pattern
6 reflection sheet
6*a* inclined face

6A white resist with a high reflection rate
6B white resist with a low reflection rate
20, **20**C, **20**E liquid crystal display apparatus
21 optical sheet
22 optical transmissive liquid crystal panel
7, **7**A, **8**B dark portion
8 light portion
9 chassis (housing)

EMBODIMENTS FOR CARRYING OUT THE INVENTION

Hereinafter, as Embodiments 1 and 2 of a light source apparatus according to the present invention, a case where each LED light source apparatus is applied to a transmissive liquid crystal panel will be described in detail with reference to drawings. Note that the thicknesses, lengths and the like of constituent elements in each of the figures are not limited to those of the illustrated structures in terms of the provided figures.

Embodiment 1

FIG. **1** is a plane view schematically showing an example of an LED module arrangement of an LED light source apparatus according to Embodiment 1 of the present invention.

In FIG. **1**, an LED light source apparatus **1** according to Embodiment 1 of the present invention is constituted of a plurality of LED modules **2**. While multiple arrays are usually provided, five rows of rectangular LED modules **2** are arranged herein for convenience sake in the transverse direction, each row comprising two LED modules **2** side by side. Among the five rows of the rectangular LED modules **2** extending in the transverse direction, although not clearly shown, the rectangular LED modules **2** in the three center rows are arranged with a dense arrangement pitch in the longitudinal direction so that the LEDs **4** in the center are arranged a little closer to each other to increase the brightness at the center portion of the screen.

Respective LED modules **2** each have a printed circuit board **3** and a plurality of (five, herein) LEDs **4** in series mounted on the printed circuit board **3**. Each row of LED modules **2** is constituted of a plurality (two on the left and right, herein) of LED modules **2**, and the two LED modules **2** on the left and right are arranged to be close to each other so that the arrangement pitch of LEDs **4** becomes equal. Thereby, the plurality of LEDs **4** are arranged at regular intervals in a matrix in the longitudinal and transverse directions. A light diffusing lens **5** covering each LED **4** for diffusing light from the LED **4** is attached to each LED **4** from the above. In this case, the light diffusing lens **5** is implemented on the printed circuit board **3**, with three pillars **5***a* underneath and the light diffusing lens **5** covering the LED **4**. The three pillars **5***a* of the light diffusing lens **5** abuts the printed circuit board **3** and is fixed thereto with adhesive (not shown) or the like. On the bottom surface of the light diffusing lens **5**, a diffusion pattern **5***b* (quadrangular pyramid, herein) of FIG. **2** is formed, which is to be described later.

A plurality of holes are opened at predetermined arrangement positions in a reflection sheet **6**, through which the light diffusing lens **5** mounted on the LED **4** penetrate together with LED **4**, by the number of LEDs **4**. With the light diffusing lenses **5**, together with the LEDs **4** mounted on the LED module **2**, penetrating the plurality of through-holes in the reflecting sheet **6** from the back side of the holes of the reflecting sheet **6**, a plurality of the printed circuit boards **3** and reflection sheet **6** are fixed to a chassis (not shown) therebelow. Light from a plurality of LEDs **4** passes through respective light diffusing lenses **5** and the light is reflected by the reflecting sheet **6** and is emitted to the front. Thereby, the LED light source apparatus functions as a diffused plane light source. A screen periphery section (frame section around a screen) of the reflecting sheets **6** is such that four long, longitudinal and transverse faces are each constituted of an inclined surface **6***a* so as to open to the front.

The featured constitution of Embodiment 1 is such that, when a plurality of light sources are arranged in a matrix in a row direction and a column direction in a plane view, a light source section with a high brightness peak value and a large light and dark contrast difference, and a light source section with a low brightness peak value and a small light and dark contrast difference, are alternately arranged for each row or each column, as will be detailed later. That is, as will be described in detail later, the featured constitution of Embodiment 1 is such that a light emitting element module **2**A with light emitted by a light source section with a high brightness peak value and a large light and dark contrast difference, and light emitting element module **2**B with light emitted by a light source section with a low brightness peak value and a small light and dark contrast difference, are alternately arranged to decrease unevenness in brightness. In this regard, although a detailed description will be provided later, in addition to the LED **4** and the light diffusing lens **5**, the light source section comprises white resists **6**A and **6**B in FIG. **2** to be described later, which are arranged on a substrate region (substrate region around the LED immediately below the light diffusing lens **5** and which function as a reflecting material. The light source section with a high brightness peak value and a large light and dark contrast difference (narrow light distribution characteristic), and the light source section with a low brightness peak value and a small light and dark contrast difference (wide light distribution characteristic) are formed by the difference in the reflection rate of the white resists **6**A and **6**B.

FIG. **2** is a longitudinal cross sectional view of a section AA' schematically showing a configuration example of an essential part of a liquid crystal display apparatus with the LED light source apparatus **1** in FIG. **1** incorporated therein and is also a figure showing brightness according to positions corresponding to the section AA'. Herein, the Figure shows three LED modules **2** in a width direction (AA' direction).

In FIG. **2**, a liquid crystal display apparatus **20** of Embodiment 1 comprises: an LED light source apparatus **1** of Embodiment 1 functioning as an LED backlight, in which a plurality of LED modules **2** are arranged for plane emission of light, each LED module **2** comprising a plurality of LEDs **4** arranged on each printed circuit board **3** and the above-mentioned light diffusing lens **5** provided to cover each LED **4**; an optical sheet **21** provided apart from a reflecting sheet **6** by a distance D above the LED light source apparatus **1**, the optical sheet **21** comprising a light diffusing sheet, a prism sheet and the like for controlling light unevenness; and a light transmissive liquid crystal panel **22** of a liquid crystal display screen provided on the optical sheet **21**, which is capable of displaying an liquid crystal image based on display signals. The LED light source apparatus **1** is provided on the back side of the light transmissive liquid crystal panel **22** to be used as a backlight.

Since the holes through which the light diffusing lenses **5** pass are opened in the reflection sheet **6**, the reflection sheet **6** is not provided on the circular printed circuit board **3** immediately below the light diffusing lens **5**. For increasing utilization efficiency of light, a white resist **6**A, **6**B (paint) is applied on the circular printed circuit board **3** immediately below the light diffusing lens **5**. The reflection rate of the

white resist **6**A, **6**B is, for example, 81 to 85%. The white resist **6**A, **6**B is also applied for the purpose of protecting wiring at the manufacturing of the printed circuit board **3**. The white resist **6**A, **6**B is applied to portions other than a wiring land section that requires electrical connection or a portion at which the pillar **5***a* of the light diffusing lens **5** abuts the base material. Since the circular white resist **6**A, **6**B, on the printed circuit board **3** immediately below the light diffusing lens **5**, is positioned immediately below the light diffusing lens **5**, it is likely that the white resist **6**A, **6**B affects the brightness above the light diffusion lens **5** directly.

Of the light once emitted from the light source section, a part of the light, which is reflected by the optical sheet **21**, such as a light diffusing sheet, to return to the light source section, and reflected by the white resist **6** applied to the surface of the base material through the light diffusing lens, and again enters the light diffusing lens **5**, has a tendency to converge at the center of the light diffusing lens **5**. Therefore, depending on the degree of the reflection rate of the white resist **6**A, **6**B, the light distribution property (diffusion of light/distribution of brightness) of light emitted from the light source varies. For example, supposing that the reflection rate of the white resist **6**A is 85% and the reflection rate of the white resist **6**B is 81%, the brightness above the center of the light diffusing lens **5** immediately above the white resist **6**A becomes increasingly high compared to the case with the white resist **6**B. In this case, the portion around the center of the light diffusing lens **5** looks brighter due to the difference in brightness. In addition, the brightness above the center of the light diffusing lens **5** immediately above the white resist **6**B is lower compared to the case of the white resist **6**A. In this case, the brightness becomes dark overall, but the difference in luminance becomes less. On the other hand, with regard to the brightness at a location apart from the center of light diffusing lens **5**, the brightness with the white resist **63** becomes larger than the brightness with the white resist **6**A. That is, when the reflection rate of the white resist is increased, the brightness becomes high at the center of the light diffusing lens, but the difference in brightness becomes large with the periphery around the center of the light diffusing lens. Accordingly, this is a light source having a large light and dark contrast as a single light source. Conversely, when the reflection rate of the white resist is reduced, the brightness becomes low at the center of the light diffusing lens, but the difference in brightness becomes small with the periphery around the center of the light diffusing lens. Accordingly, this is a light source having a small light and dark contrast as a single light source.

While the reflection rate of the white resist **6**A, **6**B is changed in units of printed circuit board **3**, an LED module **2**A in which the brightness is set to be high by the reflection rate of the white resist **6**A (for example, 85% herein; i.e., white resist **6**A with a high reflection rate), and an LED module **2**B in which the brightness is set to be low by the reflection rate of the white resist **6**B (for example, 81% herein, i.e., white resist **6**B with a low reflection rate) are alternately arranged in units of substrate section. If only the LED modules **2**A, in which brightness is set to be high and a light and dark contrast difference is set to be large, are arranged, the peak of brightness will be present at a arrangement pitch P, e.g., 50 mm, of the LED **4** and light diffusing lens **5**. However, if the LED module **2**B, in which brightness is set to be low and a light and dark contrast difference is set to be small, is arranged between the LED modules **2**A in which brightness is set to be high and a light and dark contrast difference is set to be large, then the brightness peak will be present at 100 mm, which is 2 times greater than 50 mm, as the arrangement pitch P. Furthermore, the brightness peak positions are separated from each other, and the LED modules **2**B in which brightness is set to be low and a light and dark contrast difference is set to be small, relieves the difference in the portions with lowered brightness between adjacent light diffusing lenses **5** to control the unevenness in brightness.

The optical sheet **21** functioning as a light diffusing means is arranged at an upper portion of the light source section consisting of: one or a plurality of LEDs **4** arranged two-dimensionally on a plane surface; light diffusing lenses **5** covering the LEDs **4**; and white resists **6**A or **6**B immediately below the light diffusing lenses **5**. Light from one or a plurality of light source sections is allowed to pass through the optical sheet **21**, and the light from the one or the plurality of light source sections is further spread on a plane by an effect such as diffusion, multiple reflection and retroreflection of light by the optical sheet **21**. By the overlapping of the spread pattern of the light thus obtained, plane light emission with a flat brightness characteristic is obtained.

Hereinafter, the principal of controlling unevenness in brightness according to Embodiment 1 will be further described in a specific manner.

FIG. **3** is a plane view schematically showing positions of light diffusing lenses **5** and light and dark portions of brightness, in the case of providing only an LED module **2**B in which brightness is set to be low by a reflection rate of a white resist **6**B.

As shown in FIG. **3**, in the case of the LED module **2**B in which the brightness peak value is low and the light and dark contrast difference is small, since the difference in brightness is small between the adjacent light diffusing lenses **5** in the up and down direction and the left and right direction in a plane view, the unevenness in brightness is small. However, in a space in a diagonal direction between the light diffusing lenses **5** adjacent to each other, the brightness difference occurs due to the separation of the brightness peak positions, resulting in forming a dark portion **7**. Because of this, unevenness in brightness occurs due to the dark portion **7** in the diagonal direction between the light diffusing lenses **5**. Conversely, lattice unevenness occurs due to a light portion **8**.

FIG. **4** is a plane view schematically showing positions of light diffusing lenses **5** and light and dark portions of brightness, in the case of providing only an LED module **2**A in which brightness is set to be high by a reflection rate of a white resist **6**A.

As shown in FIG. **4**, in the case of the LED module **2**A in which the brightness peak value is high and the light and dark contrast difference is large, since the difference in brightness is large between the adjacent light diffusing lenses **5** in the up and down direction and the left and right direction in a plane view, the unevenness in brightness is large, which results in forming a dark portion **7**. However, in a space in the diagonal direction between the light diffusing lenses **5** adjacent to each other, the brightness difference is small as the brightness peak positions are separated from each other. Furthermore, the lights overlap with each other, thus not causing a dark portion **7**. Because of this, the unevenness in brightness occurs due to the light portion **8** in the diagonal direction between the light diffusing lenses **5**. Conversely, lattice unevenness occurs due to the dark portion **7**.

FIG. **5** is a plane view schematically showing positions of light diffusing lenses **5** and light and dark portions of brightness in the case of Embodiment 1 alternately arranging an LED module **2**A having a high brightness peak and a large difference in light and dark contrast, and an LED module **2**B having a low brightness peak and a small difference in light and dark contrast, in units of substrate.

As shown in FIG. **5**, by alternately arranging the LED module **2**A in which the peak value of brightness is large and the difference in light and dark contrast is large, and the LED module **2**B in which the peak value of brightness is low and the difference in light and dark contrast is small, the dark portion **7** and light portion **8** in FIG. **3** overlap with the light portion **8** and dark portion **7** in FIG. **4**, so that the brightness of the dark portion **7** and the brightness of the light portion **8** are averaged, thus greatly controlling the unevenness in brightness to form the light portion **8**. In the case of a plurality of light source sections being arranged in a matrix in row and column directions in a plane view, alight source section causing lattice like unevenness due to a light part, and a light source section causing oblique like unevenness due to a light part, are alternately arranged for each row or each column. Specifically, a light source section causing first unevenness and a light source section causing second unevenness are alternately arranged, so that the first unevenness and the second unevenness are compensated with each other to be relieved. The LED module **2**B having a plurality of light source sections with a low peak value of brightness and a small difference in light and dark contrast, corresponds to the LED module having a plurality of light source sections in which lattice-like unevenness occurs due to light portions as the first unevenness. Moreover, the LED module **2**A having a plurality of light source sections with a high peak value of brightness and a large difference in light and dark contrast, corresponds to the LED module having a plurality of light source sections in which oblique unevenness occurs due to light portions as the second unevenness. In this case, the light source section comprises white resist **6**A or **6**B provided on the printed circuit board **3** immediately below the light diffusing lens **5**, as a reflecting material in addition to the LED **4** and light diffusing lens **5** as light emitting elements. The light source section with a high peak value of brightness and a large difference in light and dark contrast, and a light source section with a low peak value of brightness and a small difference in light and dark contrast, are configured (constituted) by the difference in the reflection rate of white resists **6**A, **6**B.

FIG. **6** shows this case. In FIG. **6**, the LED modules **2**A and LED modules **2**B with different degrees of brightness are alternately arranged. Between the LED module **2**A and LED module **2**B, the reflection rates of the white resist **6**A and **6**B are defined to be different. In this case, on the same substrate, a dark portion **7**A occurs between the light diffusing lenses **5** of the LED module **2**A having a high peak value of brightness and a large difference in light and dark contrast, where the dark portion **7**A is a portion with a large difference in brightness between light emitting sections and with a great reduction in light. While a dark portion **7**B occurs between the light diffusing lenses **5** of the LED module **2**B having a low peak value of brightness and a small difference in light and dark contrast, the dark portion **7**B is a portion having a small difference in brightness between the light emitting sections and having a low reduction in light. Thus, the unevenness in brightness is not much. Note that these LED module **2**A and LED module **2**B are fixed to a chassis **9** (housing).

From the foregoing, according to the LED light source apparatus **1** of Embodiment 1, the LED module **2**A having a plurality of light source sections with a high peak value of brightness and a large difference in light and dark contrast, and the LED module **23** having a plurality of light source sections with a low peak value of brightness and a small difference in light and dark contrast, are alternately arranged. The one or the plurality of light source sections comprise a white resist **6**A, **6**B provided on the substrate region around LED **4** (substrate region immediately below the light diffusing lens **5**), as a reflecting material. The light source section with a high brightness peak value and a large light and dark contrast difference, and the light source section with a low brightness peak value and a small light and dark contrast difference, are formed by the difference in the reflection rate of the white resists **6**A, **6**B.

Accordingly, a light source section having large light emission brightness on an optical axis passing through a light emitting element and small light emission brightness in a peripheral part away from the optical axis, is combined with a light source section having small light emission brightness on the optical axis passing through the light emitting element than the light emission brightness on the optical axis at the first light source section, and having large light emission brightness in a peripheral part away from the optical axis than light emission brightness at the peripheral part away from the optical axis of the first light source section, thereby relieving the decrease in emission brightness between the light source sections. As a result, the difference in brightness is relieved immediately above the light source section and between the light source sections. Thereby, the unevenness in brightness can be controlled on a screen visible to human eyes. In detail, the brightness distribution (light and dark contrast) from the light diffusing lenses **5** are intentionally regulated and managed by the difference in the reflection rates of the white resists **6**A, **6**B, and the light portion **8** and dark portion **7** are compensated with each other, thereby greatly controlling the unevenness in brightness. In addition, according to the liquid crystal display apparatus **20** of Embodiment 1, streaked unevenness in brightness occurring on an entire screen is eliminated, thereby increasing the quality of the plane light source and improving the display quality. Therefore, the unevenness in brightness is controlled in the plane light source and the display quality is improved in the plane light source. Further, since the difference in brightness is relieved immediately above the light source section and between the light source sections and the unevenness in brightness is controlled on a screen, the pitch distance of the LEDs **4** can be widened. As a result, the number of light source sections including the LEDs **4** can be reduced.

In Embodiment 1, the case has been described where the LED module **2**A having light source sections with a high peak value of brightness and a large difference in light and dark contrast, and the LED module **2**B having light source sections with a low peak value of brightness and a small difference in light and dark contrast, are alternately arranged. However, without being limited to this embodiment, even if a light source section with a high brightness peak value and a large light and dark contrast difference, and a light source section with a low brightness peak value and a small light and dark contrast difference, are alternately arranged for each light emitting element module **2**, a working effect is exerted which controls the unevenness of brightness of a plane light source and improves the display quality of the plane light source, similar to the case where the LED module **2**A having light source sections with a high peak value of brightness and a large difference in light and dark contrast, and the LED module **2**B having light source sections with a low peak value of brightness and a small difference in light and dark contrast, are alternately arranged.

In sum, in the case where a plurality of light source sections are arranged in a matrix in row and column directions, it is sufficient to arrange a light source section with a high brightness peak value and a large light and dark contrast difference, and a light source section with a low brightness peak value and a small light and dark contrast difference, alternately for each row or each column.

In addition, in Embodiment 1, the case has been described where the above-mentioned light source section comprises the white resists **6**A, **6**B provided on the printed circuit board **3** immediately below the light diffusing lens **5**, in addition to the LED **4** functioning as a light emitting element and the light diffusing lens **5** covering the LED **4**, and the light source section with a high brightness peak value and a large light and dark contrast difference and the light source section with a low brightness peak value and a small light and dark contrast difference are formed by the difference in the reflection rate of the white resists **6**A, **6**B. However, without being limited to this embodiment, reflecting sheets with different reflection rates may be provided on the printed circuit board **3** immediately below the light diffusing lens **5**, as a reflecting material. In addition, the white resist **6**A, **6**B with different reflection rates may be defined by the number of applications of white resist, and the material of the white resist may be changed in accordance with reflection rates.

Embodiment 2

In Embodiment 1, the case has been described where when a plurality of light sources are arranged in a matrix in a row direction and a column direction in a plane view, a light source section with a high brightness peak value and a large light and dark contrast difference, and a light source section with a low brightness peak value and a small light and dark contrast difference, are alternately arranged for each row or each column. In Embodiment 2, a case will be described where a light source section with a high brightness peak value and a narrow light distribution angle (light directivity), and a light source section with a low brightness peak value and a broad light distribution angle (light directivity), are alternately arranged.

Specifically, the difference from Embodiment 1 is such that a light source section with a narrow light distribution angle (light directivity) (narrow light distribution characteristic), and a light source section with a broad light distribution angle (light directivity) (broad light distribution characteristic), are used instead of using a light source section with a high brightness peak value and a large light and dark contrast difference, and a light source section with a low brightness peak value and a small light and dark contrast difference. Such a light source section with a narrow light distribution angle (light directivity) and a light source section with a broad light distribution angle (light directivity) are a light source section that causes lattice like unevenness due to a light part as first unevenness in brightness and a light source section that causes oblique like unevenness due to a light part as second unevenness in brightness, similar to the case of the light source section with a high brightness peak value and a large light and dark contrast difference and the light source section with a low brightness peak value and a small light and dark contrast difference in Embodiment 1. In the case where a plurality of light source sections are arranged in a matrix in row and column directions in a plane view, a light source section causing lattice like unevenness due to a light part and a light source section that causes oblique like unevenness due to a light part are alternately arranged for each row or each column, so that the lattice like unevenness as the first unevenness in brightness and the oblique like unevenness as the second unevenness in brightness are compensated with each other to be relieved.

FIG. **7** is a partial longitudinal cross sectional view schematically showing a configuration example of an essential part of a liquid crystal display apparatus having an LED light source apparatus according to Embodiment 2 of the present invention incorporated therein, and is also a figure indicating brightness according to positions corresponding to the subject cross-section. FIG. **8** is a partial longitudinal cross sectional view schematically showing a configuration example of an essential part of a liquid crystal display apparatus, for describing a light source section with a narrow light distribution angle. FIG. **9** is a partial longitudinal cross sectional view schematically showing a configuration example of an essential part of a liquid crystal display apparatus, for describing a light source section with a broad light distribution angle. In FIGS. **7** to **9**, the same reference numerals are used for the structural members that indicate the same functional effects as those of the structural members in FIG. **2**.

In FIG. **7** to FIG. **9**, in an LED light source apparatus **11** used as a backlight in a liquid crystal display apparatus **20**C according to Embodiment 2, an LED **4** as a light emitting element and a light diffusing lens **5** covering the LED **4** are used as the above-mentioned light source section, and the light source section with a narrow light distribution angle (light directivity) and the light source section with a broad light distribution angle (light directivity) are formed by the difference in length of a plurality of (three, herein) principal pillars **5***a***1** of a light diffusing lens **5**C of FIG. **8**, and a plurality (three, herein) of principal pillars **5***a***2** of a light diffusing lens **5**D of FIG. **9**. The length of the legs of the plurality of (three, herein) principal pillars **5***a***1** of a light diffusing lens **5**C of FIG. **8** is different from the length of the legs of the plurality (three, herein) of principal pillars **5***a***2** of a light diffusing lens **5**D of FIG. **9**. Thus, compared to the case of the light diffusing lens **5**D of FIG. **9**, a light emitting section of the LED **4** is located lower than the lower surface recess of the light diffusing lens **5**C. As a result, the brightness distribution thereof is such that the light distribution angle (light directivity) is narrow. Specifically, the light distribution angle (light directivity) is narrow by the light diffusing lens **5**C with long legs of FIG. **8** and the light distribution angle (light directivity) is broad by the light diffusing lens **5**D with long legs of FIG. **9**. Since the total amount of light from the LED **4** is the same, the brightness peak from the light diffusing lens **5**D with short legs of FIG. **9** is lower than the brightness peak from the light diffusing lens **5**C with long legs of FIG. **8**, by the difference in the light distribution angle (light directivity) broadened by the light diffusing lens **5**D.

In Embodiment 2, an LED module **2**C as a light emitting element module having one or a plurality of light source sections with a narrow light distribution angle (light directivity) and an LED module **2**D as a light emitting element module having one or a plurality of light source sections with a light distribution angle (light directivity) broader than that of the LED module **2**C, are alternately arranged in units of substrate section so that the unevenness in brightness of the two LED modules are compensated with each other to relieve the unevenness in brightness of the two. The light source section comprises an LED **4** and a light diffusing lens **5**C or **5**D, and the light source section with a narrow light distribution angle (light directivity and the light source section with a broad light distribution angle (light directivity) are formed by the difference in length of the legs (principal pillars **5***a***1**, **5***a***2**) of the light diffusing lens **5**C or **5**D.

From the foregoing, according to Embodiment 2, an LED module **2**C having one or a plurality of light source sections with a narrow light distribution angle (light directivity) and an light emitting element module **2**D having one or a plurality of light source sections with a broad light distribution angle (light directivity) are alternately arranged. Thus, a light source section having large light emission brightness on an optical axis passing through a light emitting element and

small light emission brightness in a peripheral part away from the optical axis, is combined with a light source section having small light emission brightness on the optical axis passing through the light emitting element than the light emission brightness on the optical axis at the first light source section, and having large light emission brightness in a peripheral part away from the optical axis than light emission brightness at the peripheral part away from the optical axis of the first light source section, thereby relieving the decrease in emission brightness between the light source sections. As a result, the difference in brightness is relieved immediately above the light source section and between the light source sections. Thereby, it becomes possible to control the brightness unevenness of the plane light source visible to human eyes and increase a display quality of the plane light source. In addition, since the difference in brightness is relieved immediately above the light source section and between the light source sections and the unevenness in brightness is controlled on a screen, a pitch between the LEDs **4** can be widened, and as a result, the number of light source sections, including the LED **4**, are reduced.

In Embodiment 2, the case has been described where an LED module **2**C having one or a plurality of light source sections with a narrow light distribution angle (light directivity) and an LED module **2**D having one or a plurality of light source sections with a broad light distribution angle (light directivity) are alternately arranged; however, without being limited to this embodiment, a light source section with a narrow light distribution angle (light directivity) and a light source section with a broad light distribution angle (light directivity) may be alternately arranged for each light emitting element module **2**. Even if those plurality of light source sections are arranged in a matrix in a plane view, a working effect is exerted which controls the unevenness of brightness of a plane light source and improves the display quality of the plane light source, similar to the case where an LED module **2**C having one or a plurality of light source sections with a narrow light distribution angle (light directivity) and an LED module **2**D having one or a plurality of light source sections with a broad light distribution angle (light directivity) are alternately arranged.

In sum, in the case where a plurality of light source sections are arranged in a matrix in row and column directions, it is sufficient to arrange a light source section with a narrow light distribution angle (light directivity) and a light source section with a broad light distribution angle (light directivity) alternately for each row or each column.

In Embodiment 2, the light source section with a narrow light distribution angle (light directivity) and the light source section with a broad light distribution angle (light directivity) are achieved by the difference in the length of the legs of the plurality of principal pillars **5***a* of the light diffusing lens **5**. However, without being limited to this embodiment, the light source section with a narrow light distribution angle and the light source section with a broad light distribution angle may be formed by the difference in at least either of the thickness or shape of the light diffusing lens **5**, separately from the length of the legs of the plurality of principal pillars **5***a* of the light diffusing lens **5**, or together with the length of the legs of the plurality of principal pillars **5***a* of the light diffusing lens **5**.

In addition, while the light source section with a narrow light distribution angle (light directivity) and the light source section with a broad light distribution angle (light directivity) are achieved by the difference in the length of the legs of the plurality of principal pillars **5***a* of the light diffusing lens **5**, without being limited to this embodiment, the light source section with a narrow light distribution angle (light directivity) and the light source section with a broad light distribution angle (light directivity) may be formed by the difference in the height of one or a plurality of light source sections within the LED **4** functioning as a light emitting element.

A height d**1** of one or a plurality of light emitting sections in the LED **4***a* is higher, for example as shown in FIG. **10**(*b*), than a height d**2** of one or a plurality of light emitting sections in LED **4***b*, for example, as shown in FIG. **10**(*c*). Accordingly, the light emitting sections in the LED **4***a* get closer to the light diffusing lens **5** compared to the light emitting sections in the LED **4***b*. As a result, a similar effect is achieved as the case of shortening the length of the legs of the plurality of principal pillars **5***a* of the light diffusing lens **5** to achieve the light source section with a broad light distribution angle (light directivity) in Embodiment 2. In sum, the LED **4***a* shown in FIG. **10**(*b*) can be used to form a light source section with a broad light distribution angle (light directivity); and the LED **4***b* shown in FIG. **10**(*c*) can be used to form a light source section with a narrow light distribution angle (light directivity).

Therefore, as Embodiment 2, an LED module **2**E as a light emitting element module having one or a plurality of light source sections in which a light distribution angle (light directivity) is set to be broad by the LED **4***a* with a high light emitting section, and an LED module **2**F as a light emitting element module having one or a plurality of light source sections in which a light distribution angle (light directivity) is set to be narrow by the LED **4***b* with a low light emitting section, are alternately arranged in units of substrate section, so that different types of unevenness in brightness of the LED modules are compensated with each other to relieve the unevenness in brightness of the LED modules. Thereby, the purpose of the present invention, to control unevenness in brightness of the plane light source to increase display quality of the plane light source, is achieved. Instead, the purpose of the present invention may also be achieved by alternately arranging a light source section with a narrow light distribution angle (light directivity) by the LED **4***b*, **4***a* and a light source section with a broad light distribution angle (light directivity) for each light emitting element module **2**.

Furthermore, as previously described, besides the case where the light source section with a narrow light distribution angle (light directivity) and the light source section with a broad light distribution angle (light directivity) are formed by the difference in the height of one or a plurality of light emitting sections in the LED **4** as a light emitting element, the light source sections may have LEDs **4** and the light source section with a narrow light distribution angle and a light source section with a broad light distribution angle may be formed by the difference in the shape of resin sealing sections through which light from the LED **4** is emitted. Dome-shaped sealing sections through which light from the LED **4** is emitted are filled with a fluorescent substance for changing a blue color light into a white color light, and the sealing sections also function as a lens section for narrowing down and emitting light in a predetermined direction.

In Embodiments 1 and 2, the case of Embodiment 1 has been described where a light source section with a high brightness peak value and a large light and dark contrast difference, and a light source section with a low brightness peak value and a small light and dark contrast difference, are alternately arranged, using the difference in reflection rates of white resists **6**A, **6**B or reflection sheets, are alternately arranged; and separately the case of Embodiment 2 has been described where a light source section with a narrow light distribution angle (light directivity) and a light source section

with a broad light distribution angle (light directivity) are alternately arranged with light diffusing lenses **5**C, **5**D. However, the objective of the present invention, to control the brightness unevenness of the plane light source and increase a display quality of the plane light source, may be achieved by combining Embodiments 1 and 2. In Embodiment 2, the light source section with a narrow light distribution angle (light directivity) and the light source section with a broad light distribution angle (light directivity) are achieved by forming the principal pillars **5***a***1** of the light diffusing lens **5**C longer than the principal pillars **5***a***2** of the light diffusing lens **5**D. However, without being limited to this embodiment, the light source section with a narrow light distribution angle (light directivity) and the light source section with a broad light distribution angle (light directivity) may be achieved by the difference in the thickness or shape of the light diffusing lens. Furthermore, in the case of combining Embodiments 1 and 2, a similar effect in the case of changing the length of the legs of the principal pillars **5***a* of the light diffusing lens **5** may also be obtained, for example, in the case of fixing the principal pillars **5***a* of the light diffusing lens **5** on the white resists **6**A, **6**B and reflection sheets of different reflection rates, and in the case of fixing the principal pillars **5***a* of the light diffusing lens **5** on a substrate region where white resists **6**A, **6**B and reflection sheets of different reflection rates are not provided. As a matter of course, similar to the case of changing the length of the legs of the principal pillars **5***a* of the light diffusing lens **5** as in the case of Embodiment 2, the effect of the present invention may be obtained even in the case of mounting light diffusing lenses **5** on white resists and reflection sheets of the same reflection rate as well as the substrate region without any white resists or reflection sheets.

While Embodiments 1 and 2 have described the LED light source apparatus **1**, **11**, and **12** using the LED **4** as a light emitting element, the light emitting element may be a combination of a laser element and a fluorescent substance.

As such, the present invention has been exemplified by using the preferable Embodiments 1 and 2 of the present invention; however, the present invention should not be interpreted only based on the Embodiments 1 and 2. It is understood that the scope of the present invention should be interpreted solely based on the claims. It is also understood that those skilled in the art can implement equivalent scope of technology, based on the description of the present invention, from the description of the detailed preferred Embodiments 1 and 2 of the present invention. Furthermore, it is understood that any patent, any patent application and any references cited in the present specification would be incorporated by reference in the present specification in the same manner as the contents are specifically described therein.

INDUSTRIAL APPLICABILITY

In the field of a light source apparatus, in which a plurality of LED modules and the like equipped with a plurality of light emitting diodes (LED) as a light source, are used and a liquid crystal display apparatus in which the light source apparatus is used as a back light, according to the present invention, alight source section having large light emission brightness on an optical axis passing through a light emitting element and small light emission brightness in a peripheral part away from the optical axis, is combined with a light source section having small light emission brightness on the optical axis passing through the light emitting element than the light emission brightness on the optical axis at the first light source section, and having large light emission brightness in a peripheral part away from the optical axis than light emission brightness at the peripheral part away from the optical axis of the first light source section, thereby relieving the decrease in emission brightness between the light source sections. As a result, the difference in brightness is relieved immediately above the light source section and between the light source sections, and it becomes possible to control unevenness in brightness on a screen visually sensed by humans. As a result, it becomes possible to increase a display quality of the plane light source. As such, since the difference in brightness is relieved immediately above the light source section and between the light source sections and the unevenness in brightness is controlled on a screen, the pitch between the light emitting elements can be widened, and as a result, the numbers of light source sections can be reduced.

The invention claimed is:

1. A light source apparatus, comprising a plurality of light emitting element modules provided therein, in which a plurality of light source sections each comprising a light emitting element are mounted on a substrate, for all of the plurality of light source sections simultaneously emitting light planarly,

the plurality of light source sections comprising a light source section with a narrow light distribution property having a brightness peak that is high and a light source section with a broad light distribution property having the brightness peak that is low, wherein when a plurality of the light source sections are arranged in a matrix in a row direction and a column direction in a plane view, the light source section with a narrow light distribution property having a brightness peak that is high and the light source section with a broad light distribution property having the brightness peak that is low are being alternately arranged for only each row or only each column, wherein

the light source section comprises a reflecting material provided on a substrate region around the light emitting element, in addition to the light emitting element, and

the light source section with high contrast and the light source section with low contrast are formed by the difference in a reflection rate of the reflecting material.

2. A light source apparatus according to claim **1**, wherein the light source section with the narrow light distribution property is a light source section with a high contrast, and the light source section with the broad light distribution property is a light source section with a low contrast.

3. A light source apparatus according to claim **2**, wherein the light emitting element module comprising the plurality of light source sections with the high contrast, and the light emitting element module comprising the plurality of light source sections with the low contrast are alternately arranged.

4. A light source apparatus according to claim **2**, wherein the light source section with the high contrast and the light source section with the low contrast are alternately arranged in each of the plurality of light emitting element modules.

5. A light source apparatus according to claim **1**, wherein a lens is mounted for each light emitting element, and the substrate region around the light emitting element is a substrate region immediately below the lens.

6. A light source apparatus according to claim **1**, wherein the light source section with the narrow light distribution property is a light source section with a narrow light distribution angle, and the light source section with the broad light distribution property is a light source section with a broad light distribution angle.

7. A light source apparatus according to claim **6**, wherein the light emitting element module comprising the plurality of light source sections with the narrow light distribution angle, and the light emitting element module comprising the plural-

ity of light source sections with the broad light distribution angle are alternately arranged.

8. A light source apparatus according to claim **6**, wherein the light source section with the narrow light distribution angle and the light source section with the broad light distribution angle are alternately arranged in each of the plurality of light emitting element modules.

9. A light source apparatus according to claim **6**, wherein:

the light source section comprises the light emitting element and the lens mounted for each light emitting element; and

the light source section with the narrow light distribution angle and the light source section with the broad light distribution angle are formed by the difference in at least any of a length of a plurality of principal pillars of the lens, a thickness of the lens and a shape of the lens.

10. A light source apparatus according to claim **6**, wherein:

the light source section comprises the light emitting element; and

the light source section with the narrow light distribution angle and the light source section with the broad light distribution angle are formed by the difference in a height of light emitting sections of the light emitting element.

11. A light source apparatus according to claim **6**, wherein:

the light source section comprises the light emitting element; and

the light source section with the narrow light distribution angle and the light source section with the broad light distribution angle are formed by the difference in a shape of a sealing section through which light from the light emitting element is emitted.

12. A light source apparatus according to claim **1**, wherein:

a light diffusing means is arranged on an upper part of a plurality of light emitting elements arranged two dimensionally; light from the plurality light emitting elements is transmitted through the light diffusing means; and the light from the plurality of light emitting elements is further spread planarly by an effect of diffusion, multiple reflection and retroreflection of light by the light diffusing means; and plane light emission with a flat brightness characteristic is obtained by overlapping a spread pattern of the obtained light.

13. A liquid crystal display apparatus comprising the light source apparatus according to claim **1**, provided on a back surface side of a liquid crystal panel, to be used as a backlight.

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